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**SOME OBSERVATIONS ON CORNEAL ASTIGMATISM  
AND CONDITIONS THAT CHANGE  
CORNEAL CURVATURE.**

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The object of this paper is to call attention to a not infrequent phenomenon met with by those who work much with the opthalmometer, viz., changes which occur in corneal curvature.

You will recall that up to about twenty years ago the cornea was considered to be sufficiently hard and firm as to be unchangeable, unless inflamed; and that the astigmatism of the eye remained the same throughout life, undergoing no change of any kind. Of course there were numerous cases in which an astigmatic refraction ordered by a skillful ophthalmologist was changed to a cylinder of different degree of axis, or both, by another ophthalmologist equally skillful, the latter contenting himself with the thought that the first correction was not accurate. Doubtless often both pairs of glasses were correct at the time prescribed, the corneal curvature having changed in the interim.

Of late years it has been scientifically demonstrated that in cases of glaucoma there is a change in the curvature of the cornea accompanied usually by a change in the relation of the axis of greatest curvature—that of the horizontal meridian becoming more curved, and the vertical more flattened. The increased pressure from within is often manifested in this way before any of the marked glaucomatous symptoms appear. An eye which undergoes a change of this kind, an increase in curvature of the horizontal meridian, should be watched with suspicion.

The subject of the changes of corneal curvature after cataract operations has attracted considerable attention in the past few years. It seems evident that if a curved surface be incised and the edges of the incision be separated by a mass of lymph, the curvature will be changed; and as the mass of lymph is gradually absorbed, so gradually will the curvature approach the more nearly to its original condition. If the Graefe incision be above or below, the effect will be to flatten the horizontal meridian; while if to the side, the vertical meridian will undergo a like change.

Besides these changes in corneal curvature there are others which occur in corneæ apparently poorly nourished, especially in patients of rheumatic, syphilitic, tubercular, or scrofulous diathesis. These changes occur not only from day to day, or from week to week, but also instantaneously, apparently as the result of the pressure of the lids and the external eye muscles. *I have found the corneal astigmatism to change from two to three diopters in perhaps eight or ten seconds, and the axis as much as  $25^{\circ}$  in these cases.* These changes have been noted not alone in one case, but perhaps in from fifty to sixty patients. The variations have of course been rarely as great as here noted, usually changes of from 0.25 to 1.00 diopters being noted. The instru-

ment by which these observations were made was the Javal-Schiötz ophthalmometer, made for me in 1892, by Myrowitz, of New York, and was used in the manner described by me in the *New York Medical Journal*, viz., strapping the head firmly in the head-rest, with the patient's arms resting on the table and the feet on the floor.

When first observed these sudden changes in the corneal curvature gave rise to the suspicion that something was wrong; that perhaps the apparent change in curvature must be due to a change in the depth of the layer of conjunctival fluid on the cornea. Guarding against this by the closure of the eyelids and the taking of new observations, as well as by the use of castor-oil or glycerin on the cornea, the same results were obtained.

Of interest in this connection, and confirming the observations, is the fact that the majority of these cases were examined at frequent intervals after they were put on local as well as dyscrasic treatment, and as their general health improved not only did the curvature become more constant, but the vision improved as well. May not some of the many cases of spasm of accommodation of which we have heard be truly relegated to cases of weakened corneal tissue with instantaneous changes in its curvatures?

I believe this change in the curvature but rarely occurs in good healthy corneæ, not that there could not be theoretically sufficient pressure from within or without to occasion it. I believe it to be not infrequently present in the rheumatic and gouty, in the scrofulous and syphilitic, and in tuberculous subjects. Nearly all of these cases have been either in patients suffering from the above constitutional weakness or in those convalescent from long-continued fevers. In many cases I have observed the amount of corneal astigmatism of the prin-



principal axes to be altered under the influence of a mydriatic. In glaucoma the corneal nutrition is interfered with and at the same time the extra pressure from within is exerted upon the weakened cornea.

*These observations will in some part explain those cases which wander from doctor to doctor, obtaining from each a prescription for a pair of glasses, none of which prove of positive value to the patient. To such patients no astigmatic glasses can be of use until the nutrition of the cornea is so thoroughly restored that the curvatures remain constant.* These cases will demand, first of all, careful examination, and after the diagnosis of changeable corneal curvatures is made then the history and general health must be carefully studied, and when once the diagnosis is accurately made, treatment must be directed to the general as well as the local conditions. When the cornea becomes more thoroughly nourished, the curvatures remain more constant, and there is little or no variation in the axes. We are now almost ready to order glasses should such be deemed necessary.

*Glasses ordered before this fixity in the curvature has been obtained will prove but a source of annoyance, whereas, if ordered afterward will be a source of comfort and relief.*

I have endeavored to give but a sketch of a truth—namely, that well-nourished corneæ withstand the ordinary variations of pressure exerted from within or without, without causing any material change in the principal axes or in the curvatures, whereas, if the corneæ are poorly nourished these variations are often sufficient to change materially not only the curvatures but also the principal meridians. Abnormal or extreme changes in pressure, whether exerted from without or from within the eye, are attended usually by a change in corneal curvature as well as by an occasional alteration in its principal meridians.